



1 Write down the error interval for each measurement.

- A length, L cm, is 8.4 cm correct to 1 decimal place.
- A mass, m grams, is 450 grams correct to the nearest 10 grams.
- A number, x , is 3.7 when truncated to 1 decimal place.
- The number of people, n , at a match is 600 correct to 1 significant figure.

(4 marks)

a)

Rounded to 0.1, so ± 0.05

$$8.35 \leq L < 8.45$$

b)

Rounded to 10, so ± 5

$$445 \leq m < 455$$

c)

Truncated: cut off, so no $\pm$ half

$$3.7 \leq x < 3.8$$

d)

1 s.f. here means nearest 100, so ± 50

$$550 \leq n < 650$$

2 $y = 7.8$ correct to 1 decimal place.

$z = 4.1$ correct to 1 decimal place.

- Write down the upper bound of y .
- Work out the upper bound of $y - z$.

(3 marks)

(a) y is 7.8 to 1 dp, so $7.75 \leq y < 7.85$. The upper bound of y is 7.85

(b) To make $y - z$ as large as possible, use the upper bound of y and the lower bound of z

The lower bound of z is 4.05

$$7.85 - 4.05 = 3.8, \text{ so the upper bound of } y - z \text{ is } 3.8$$

3

$a = 18.4$ correct to 1 decimal place.

$b = 2.7$ correct to 1 decimal place.

Calculate the upper bound of $\frac{a}{b}$

Give your answer correct to 3 significant figures.

(3 marks)

To make $a \div b$ as large as possible, use the upper bound of a and the lower bound of b

Upper bound of $a = 18.45$, lower bound of $b = 2.65$

$$18.45 \div 2.65 = 6.96226..$$

To 3 significant figures the upper bound is 6.96

6.96

4

A rectangle has length 12.4 cm and width 7.5 cm. Each is correct to 1 decimal place.

a. Work out the upper bound of the perimeter of the rectangle.

b. Work out the upper bound of the area of the rectangle.

(4 marks)

Upper bounds: Length 12.45, width 7.55

a.)

$$P = 2 \times (12.45 + 7.55)$$

$$= 2 \times 20$$

40 cm

b.)

$$A = 12.45 \times 7.55$$

93.9975 cm²

5

A tram travels a distance of 260 metres, correct to the nearest 10 metres.

The journey takes 32.5 seconds, correct to 1 decimal place.

Calculate the lower bound of the average speed of the tram in m/s.

Give your answer correct to 3 significant figures.

(3 marks)

Average speed = distance $\div$ time. For the lower bound, use the lower bound of the distance and the upper bound of the time

Lower bound of distance = 255 m. Upper bound of time = 32.55 s

$$255 \div 32.55 = 7.8341..$$

To 3 significant figures the lower bound is 7.83 m/s

7.83

- 6 Sam's bag has mass 6.4 kg and Ali's bag has mass 4.9 kg. Each mass is correct to the nearest 0.1 kg. Work out the lower bound of the difference in mass between the two bags.

(3 marks)

Smallest difference = smallest - largest

Sam: lower bound 6.35

Ali: upper bound 4.95

$$= 6.35 - 4.95$$

1.4 kg

- 7 The volume of a cube is 730 cm^3 , correct to 2 significant figures. Work out the lower bound of the length of one edge of the cube. Give your answer correct to 3 significant figures.

(4 marks)

730 to 2 significant figures means $725 \leq \text{volume} < 735$

The lower bound of the volume is 725 cm^3

Edge length = cube root of volume, so the lower bound of the edge is the cube root of 725

$$725^{\frac{1}{3}} = 8.9835..$$

To 3 significant figures the lower bound is 8.98 cm

8.98

8

In a right-angled triangle, the angle at A is x° .

The side opposite angle A has length 5.2 cm, correct to 1 decimal place.

The side adjacent to angle A has length 8.4 cm, correct to 1 decimal place.

Calculate the lower bound of x .

Give your answer correct to 1 decimal place.

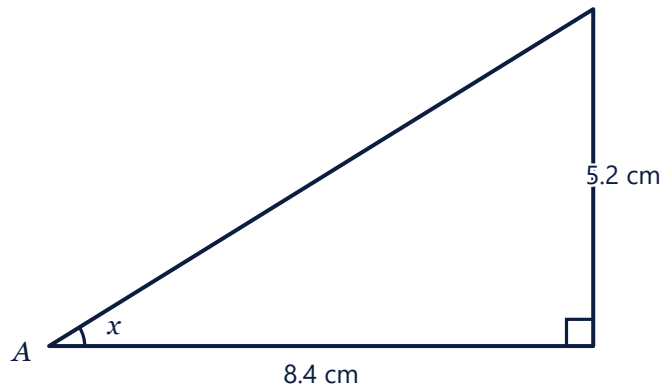


Diagram NOT accurately drawn

(3 marks)

$$\tan x = \text{opposite} \div \text{adjacent}$$

To make x as small as possible, make $\tan x$ as small as possible: use the lower bound of the opposite side and the upper bound of the adjacent side

Lower bound of opposite = 5.15 cm. Upper bound of adjacent = 8.45 cm

$$\tan x = 5.15 \div 8.45 = 0.60946..$$

$x = \tan^{-1}(0.60946...) = 31.36...^\circ$, so the lower bound of x is 31.4° to 1 dp

31.4

9

The formula $v = u + at$ gives the final velocity of an object.

$v = 27.3$ correct to 1 decimal place.

$u = 11.6$ correct to 1 decimal place.

$t = 4.5$ correct to 1 decimal place.

By rearranging the formula, calculate the upper bound of a .

Give your answer correct to 3 significant figures.

(4 marks)

Rearrange

$$a = (v - u) \div t$$

For the upper bound of a , make the numerator as large as possible and the denominator as small as possible

Use the upper bound of v (27.35), the lower bound of u (11.55) and the lower bound of t (4.45)

$$a = (27.35 - 11.55) \div 4.45 = 15.8 \div 4.45 = 3.5505..$$

To 3 significant figures the upper bound of a is 3.55

3.55

10

Last week Ben worked for 7.5 hours, correct to the nearest half hour.

He was paid £84, correct to the nearest pound.

Ben says, "My hourly rate of pay was definitely more than £10.90."

Determine whether Ben is correct.

You must show your working using bounds.

(4 marks)

Hourly rate = pay $\div$ hours. The lower bound of the rate uses the lower bound of the pay and the upper bound of the hours

Pay to the nearest pound

$$\text{Lower bound} = £83.50. \text{ Hours to the nearest half hour: upper bound} = 7.75 \text{ hours}$$

$$\text{Lower bound of rate} = 83.50 \div 7.75 = £10.7741... = £10.77 \text{ (2 dp)}$$

$£10.77 < £10.90$, so the rate was not definitely more than £10.90. Ben is not correct

The upper endpoint 7.75 hours is excluded, so this lower bound is not attained. For a valid example, £83.50 over 7.7 hours gives about £10.84 per hour, below £10.90; both measurements round as stated

11

A circle has radius 6.5 cm, correct to 1 decimal place.

Work out the area of the circle to a suitable degree of accuracy. You must show your working and explain why your answer is suitable.

(4 marks)

$$6.45 \leq r < 6.55$$

$$\text{Lower: } \pi \times 6.45^2 = 130.698\dots$$

$$\text{Upper: } \pi \times 6.55^2 = 134.782\dots$$

Round both to 2 s.f.: 130 and 130

Round both to 3 s.f.: 131 and 135 (different)

$$130 \text{ cm}^2 \text{ (2 s.f.)}$$

12

A metal block has mass 485 g, correct to the nearest gram.

The volume of the block is 62.4 cm^3 , correct to 1 decimal place.

density = mass $\div$ volume

Work out the density of the metal in g/cm^3 , giving your answer to a suitable degree of accuracy.

You must explain why your answer is to a suitable degree of accuracy.

(5 marks)

$$\text{Upper bound of density} = \text{upper bound of mass} \div \text{lower bound of volume} = 485.5 \div 62.35 = 7.7866\dots$$

$$\text{Lower bound of density} = \text{lower bound of mass} \div \text{upper bound of volume} = 484.5 \div 62.45 = 7.7582\dots$$

To 2 significant figures both bounds round to 7.8

So the density is 7.8 g/cm^3 , because the upper and lower bounds agree to this degree of accuracy

13

A cyclist travels 93.6 metres, correct to 1 decimal place.

The ride takes 12.0 seconds, correct to 1 decimal place.

Calculate the average speed of the cyclist in m/s , giving your answer to a suitable degree of accuracy.

You must show your working and explain your answer.

(5 marks)

$$\text{Speed} = \text{distance} \div \text{time}$$

$$\text{Upper bound of speed} = 93.65 \div 11.95 = 7.8368\dots$$

$$\text{Lower bound of speed} = 93.55 \div 12.05 = 7.7634\dots$$

To 2 significant figures both bounds round to 7.8

So the average speed is 7.8 m/s , because the upper and lower bounds agree to this degree of accuracy

- 14 The kinetic energy, E joules, of an object is given by

$$E = \frac{1}{2}mv^2$$

$m = 1.2$ kg, correct to 1 decimal place.

$v = 8.4$ m/s, correct to 1 decimal place.

- Work out the upper bound of E . Give your answer correct to 3 significant figures.
- The lower bound of E is 40.1 joules, correct to 3 significant figures. Write down the value of E to a suitable degree of accuracy. Give a reason for your answer.

(5 marks)

(a) For the upper bound of E use the upper bounds of m and v

Upper bound of $m = 1.25$, upper bound of $v = 8.45$

$$E = 0.5 \times 1.25 \times 8.45^2 = 0.5 \times 1.25 \times 71.4025 = 44.6265..$$

To 3 significant figures the upper bound is 44.6 joules

(b) The bounds are 40.09... and 44.62... To 1 significant figure both round to 40

So $E = 40$ joules to 1 significant figure, because the upper and lower bounds agree at this degree of accuracy

- 15 A car travels 250 miles, correct to the nearest 10 miles, using 31 litres of fuel, correct to the nearest litre.

Work out the fuel economy in miles per litre to a suitable degree of accuracy. You must show your working and give a reason for your answer.

(5 marks)

Distance: $245 \leq d < 255$

Fuel: $30.5 \leq f < 31.5$

Largest result = largest $\div$ smallest

$$UB = 255 \div 30.5 = 8.36...$$

Smallest result = smallest $\div$ largest

$$LB = 245 \div 31.5 = 7.77...$$

Both bounds round to 8 (1 s.f.)

8 miles per litre